



GOVERNMENT OF PUERTO RICO  
DEPARTMENT OF NATURAL AND ENVIRONMENTAL RESOURCES

**PUERTO RICO 1-HOUR SO<sub>2</sub> NON-ATTAINMENT AREA  
STATE IMPLEMENTATION PLAN**

2019-2029 PROJECTED EMISSION INVENTORY-IRP

Date: MAY2022

**Contents**

ACRONYMS ..... 3

1.0 Summary ..... 4

2.0 Introduction ..... 5

3.0 Projected Emission Inventory Areas ..... 6

4.0 Stationary Point Sources..... 7

    a. PREPA Aguirre ..... 7

    b. PREPA San Juan ..... 7

    c. PREPA Palo Seco..... 7

5.0 Projected Emission Inventory 2019-2029-IRP ..... 8

Figure 1: San Juan Non-Attainment Area ..... 9

Figure 2: Guayama-Salinas Non-Attainment Area ..... 10

Table 1: PREPA Projected SO<sub>2</sub> Allowable Emissions 2019-2029 ..... 11

Figure 3: PREPA Permit PTE and New Projected PTE 2019-2029 ..... 12

References ..... 13

APPENDIX-A ..... 14

## ACRONYMS

AAMN	Attainment Ambient Monitoring Network
AERMOD	AMS/EPA Regulatory Model
BEI2014	Baseline Emission Inventory 2014
CAA	Clean Air Act
PRDNER	Puerto Rico Department of Natural and Environmental Resources
DRR	Data Requirements Rule
EBFRO	Energy Bureau Final Resolution & Order
EQB	Environmental Quality Board
USEPA	United States Environmental Protection Agency
FIP	Federal Implementation Plan
FR	Federal Register
IRP	Integrated Resource Plan
NAAQS	National Ambient Air Quality Standards
PPB	Parts Per Billion
PREB	Puerto Rico Energy Bureau
PREPA	Puerto Rico Electric Power Authority
PTE	Potential to Emit
SIP	State Implementation Plan
SO <sub>2</sub>	Sulfur Dioxide
TPY	Tons Per Year
TSD	Technical Support Document
ULSD	Ultra Low Sulfur Diesel
ULSDF	Ultra Low Sulfur Diesel Fuel

## 1.0 Summary

In June 2010, the USEPA promulgated the new 1-hour primary sulfur dioxide (SO<sub>2</sub>) National Ambient Air Quality Standard (NAAQS) of 75 parts per billion (ppb), which is met at an ambient air quality monitoring site, when the 3-year average of the 99<sup>th</sup> percentile of 1-hour daily maximum concentrations does not exceed 75 ppb.

In March 2017, the Environmental Quality Board (EQB), hereafter, Puerto Rico Department of Environmental and Natural Resources (PRDNER), submitted to USEPA, information to be included in the Technical Support Document (TSD)<sup>1</sup>, along with the 1-hour SO<sub>2</sub> modeling assessment and boundaries recommendations for the designation of Puerto Rico area. USEPA evaluate the PRDNER assessment and submit comments. PRDNER review the comments, and submitted additional information between October and November 2017, which addressed the concerns, and allowed USEPA to finalize the 1- hour SO<sub>2</sub> designation for Puerto Rico.

On January 2018, the USEPA published in the Federal Register (83 FR 1098) the Air Quality Designations for the 2010 Sulfur Dioxide (SO<sub>2</sub>) Primary National Ambient Air Quality Standard-Round 3. The final rule established the nonattainment designation of the 1-Hour SO<sub>2</sub> NAAQS, for two areas in Puerto Rico; including several wards in different counties. The Clean Air Act (CAA), directs the Government of states and territories together with the regulatory agencies for those areas designated as nonattainment to submit the Non-Attainment Sulfur Dioxide State Implementation Plan within 18 months of the effective date of the designation.

The areas in Puerto Rico that are classified as nonattainment for the 1-hour SO<sub>2</sub> NAAQS are San Juan and Guayama-Salinas. The USEPA TSD contains detailed information about the areas in Puerto Rico that are part of the Round 3 designation process, and all technical data submitted, as part of the 1-hour SO<sub>2</sub> designation assessment.

On October 2019, PRDNER prepared and submitted to USEPA, the SO<sub>2</sub> Baseline Emission Inventory 2014<sup>2</sup> for each nonattainment area, using the 2014 actual emissions. The baseline emission inventory presents the actual SO<sub>2</sub> emissions data for the baseline year of 2014. The year 2014 was selected as the baseline year, because the SO<sub>2</sub> emissions data was the most complete for all sectors included in the inventory, and the designation model was based on actual emission data for the years 2013-2015. PRDNER discussed with USEPA the selection of the 2014 as baseline year, and USEPA agree with PRDNER about using 2014 emissions data for the emission inventory.

---

<sup>1</sup> Technical Support Document: Intended Round 3 Area Designations for the 2010 1-Hour SO<sub>2</sub> Primary National Ambient Air Quality Standard, August 2017. <https://www.epa.gov/sulfur-dioxide-designations/final-technical-support-documents-area-designations-round-3>

<sup>2</sup>2014 Baseline Emission Inventory 1-Hour SO<sub>2</sub> State Implementation Plan. DNER, October 2019.

On October 8, 2020, the EPA found that Puerto Rico, among other states or territories, failed to submit complete SIP showing how their respective areas will address nonattainment of the 2010 1-hour primary SO<sub>2</sub> NAAQS.

These findings of failure to submit attainment plans for the 2010 SO<sub>2</sub> NAAQS establish a 24-month deadline for USEPA to either approve SIPs for the affected areas or finalize Federal Implementation Plans (FIPs) that address attainment in each area. PRDNER is working on this time schedule submittal, and the projected emission inventory is part of the Non-Attainment Sulfur Dioxide State Implementation Plan. The 2019-2029 Projected Emission Inventory for each nonattainment area, includes the projected allowable emission or potential to emit rate (PTE) rate that provide attainment of the 1- hour SO<sub>2</sub> NAAQS, using the compliance option plan that is described next.

## 2.0 Introduction

PRDNER has been working to find strategies of compliance with the 1- hour SO<sub>2</sub> NAAQS in the nonattainment areas of San Juan and Guayama-Salinas. The previous attainment strategies, considered the PREPA's emission unit fuel conversion to Liquefied Natural Gas (LNG). The Puerto Rico Energy Board (PREB) submitted comments during the 1- hour SO<sub>2</sub> public hearing period, where indicated that the PREPA emission units fuel conversion to LNG, was not in agreement with the Puerto Rico Integrated Resource Plan (IRP)<sup>3</sup>. PREB public hearing comments stated that the attainment strategy must be revised and changed, according to the recommendations presented in the IRP.

After the 1- hour SO<sub>2</sub> SIP Public Hearing, PRDNER held meetings with PREB and the Financial Oversight and Management Board (FOMB). The recommendation presented to PRDNER during these meetings was to follow the IRP integration of renewable energy sources, and the proposed emission unit retirements in the PREPA fleet, instead of the PREPA's emission unit conversion to LNG.

The compliance strategy is in conformity with the IRP, that considers specific power generation addition, and emission unit retirements of the PREPA fleet. The generation capacity additions are renewables and battery storages resources within a five-year Action Plan period. These renewable sources will add 3750 MW to the energy grid. The IRP also considers the retirements of boilers, gas turbines and replacement of peaker units in PREPA.

---

<sup>3</sup> Puerto Rico Integrated Resource Plan 2018-2019, Draft for the Review of the Puerto Rico Energy Bureau. Puerto Rico Power Electric Authority. June 2019.

PREPA is in a transition to Ultra Low Sulfur Diesel Fuel (ULSDF) for their gas turbines and combined cycle, along with the integration of the aforementioned renewable energy sources. Moreover, this changes in PREPA generation, an Attainment Ambient Monitoring Network (AAMN) is going to be established in both nonattainment areas (6 monitors per area).

The projected emission inventory presents the SO<sub>2</sub> emissions reductions in the nonattainment areas, that provide attainment of the 1- hour SO<sub>2</sub> NAAQS. The inventory includes the retirements of the PREPA emission units with the projected retirements dates that are included in the IRP, taking into consideration the integration of the renewable energy to the power generation grid.

PREB provided PRDNER a schedule of retirements for the PREPA steam generating units, based on the integration of this renewable energy to the system. PREB mentioned that once the renewable energy projects start, the older emission units in PREPA fleet will be retired or replaced by this new generation. According to PREB's retirement schedule, the SO<sub>2</sub> emission reductions projection, due to the PREPA emission unit retirements will be completed around year 2025 for San Juan area, and in year 2029 for Guayama-Salinas area. A copy of the PREB/IRP retirement schedule is in the Appendix.

### 3.0 Projected Emission Inventory Areas

The nonattainment San Juan area includes the following municipalities and wards; within Cataño (the entire municipality including Palmas and Barrio Pueblo Wards), in Toa Baja (Palo Seco and Sabana Seca Wards), within Guaynabo (Pueblo Viejo Ward), in Bayamón (Juan Sánchez Ward) and in San Juan (San Juan Antiguo, Santurce, Hato Rey Norte and Gobernador Piñero Wards). The rest of the wards in each municipality were classified as attainment/unclassified.

The San Juan nonattainment area is located to the north of the island and part of the municipalities and the wards are near the coastline. The nonattainment area is shown in Figure 1.

The nonattainment designation for the Guayama-Salinas area was as following; the Guayama municipality was classified as attainment/unclassified and for Salinas, the nonattainment areas considers the Aguirre and Lapa Wards. The remaining wards in Salinas municipality, were classified as attainment/unclassified.

The Guayama-Salinas nonattainment area is located to the south of the island along the coastline. The nonattainment area is shown in Figure 2.

#### 4.0 Stationary Point Sources

The projected emission inventory includes the potential SO<sub>2</sub> emissions for PREPA San Juan and Palo Seco in San Juan, and PREPA Aguirre in Guayama-Salinas area. All PREPA sources emit more than 2000 tpy of SO<sub>2</sub> (DRR)<sup>4</sup>, and the air quality modeling analysis demonstrate their significant contribution to the violations of the 1-hour SO<sub>2</sub> NAAQS.

##### a. PREPA Aguirre

The Puerto Rico Energy Power Authority (PREPA) Aguirre Power Plant, is an electric generating facility located in Salinas, Puerto Rico. The facility operates twelve (12) electric generating units that includes: two boilers (Units AG1 and AG2) each rated at 4,180 million British Units per hour (MMBtu/hr) firing No. 6 oil; eight combustion turbines (Units CC1-1, CC1-2, CC1-3, CC1-4, CC2-1, CC2-2, CC2-3 and CC2-4) operating in combine cycle mode, each rated at 607.5MMBtu/hr, firing fuel oil No. 2; and two combustion turbines (Units AGGT 2-1 and AGGT 2-2) operating in single cycle mode each rated at 301.5 MMBtu/hr firing No.2 oil. The balance of the facility includes eight emergency generators engines and other insignificant emission sources.

##### b. PREPA San Juan

The Puerto Rico Energy Power Authority (PREPA) San Juan Power Plant, is an electric generating facility, located on the north of Puerto Rico coast, in San Juan. The facility consists of four (4) oil fired steam electric generating units: four boilers provided with steam generators. The boiler units SJ7, SJ8, SJ9, and SJ10 consume residual fuel. Each boiler has the capacity of 1007.3 MMBtu/hr. The facility also operates two (2) combustion turbines, Units 5 and 6, which are distillate oil and natural gas fired. Each unit have a capacity 1694 MMBtu/hr at base load.

##### c. PREPA Palo Seco

The Puerto Rico Energy Power Authority (PREPA) Palo Seco, is an electric generating facility, located on the north of Puerto Rico coast, in Toa Baja. The facility operates ten (10) generating units that includes: two boilers (PS1 and PS2) each rated at 857.7 MMBtu/hr firing No. 6 fuel oil; two boilers (PS3 and PS4) each rated at 1971 MMBtu/hr firing No. 6 fuel oil; and six combustion turbines (Units PSGT 1-1, 1-2, 2-1, 2-2, 3-1, 3-2) operating in simple cycle mode, each rated at 301.5 MMBtu/hr, firing fuel oil No.2. Recently PREPA Palo Seco added three additional combustion turbines (FT8 Mobile Pack 1, 2 and 3) firing dual fuel No.2 and natural gas.

---

<sup>4</sup> Data Requirements Rule for 2010 1-Hour Sulfur Dioxide (SO<sub>2</sub>) Primary National Ambient Air Quality Standard (NAAQS). 40 CFR Part 51.

The SO<sub>2</sub> projected emission inventory has the emissions reductions that provide attainment with the 1- hour SO<sub>2</sub> NAAQS. These controls included the fuel switching to ULSD, and the retirements of emission units in PREPA facilities according to the IRP and PREB data. These emission unit retirements consider the operating scenarios in the IRP, and the recommendations of the Puerto Rico Energy Bureau in their Final Resolution and Order on the Puerto Rico Electric Power Authority's Integrated Resource Plan<sup>5</sup> (EBFRO).

Other changes that PREPA are implementing to reduce their SO<sub>2</sub> emissions are, the transitioning to ULSD for their gas turbines and combined cycle, along with the integration of renewable energy sources. The projected emission inventory calculations are included in the Appendix.

#### 5.0 Projected Emission Inventory 2019-2029-IRP

The projected emission inventory considers the 1- hour SO<sub>2</sub> projected potential emissions, that resulted from the integration of renewable sources and the PREPA's emission unit retirements. This inventory includes the control measures and enforceable emissions limitations that provide attainment with the 1- hour SO<sub>2</sub> NAAQS.

The projected emission inventory also considers the transition from regular diesel to ULSD, as an Interim Plan. The projected emission inventory is based on potential SO<sub>2</sub> emissions. PREPA certified all emission data for the ULSD fuel switch and the emissions calculation are in Appendix.

The Table 1 presents the emission units that will be retired in PREPA facilities, and the emission units that will stay operating with their respective projected SO<sub>2</sub> potential emissions. The Figure 3 shows the PREPA's current permit SO<sub>2</sub> potential to emit, and the projected emission reductions that provides attainment of the 1-hour SO<sub>2</sub> NAAQS.

The projected emission inventory will extend beyond the attainment date of April 9, 2023, due to the renewable sources installation delay. Although PRDNER recognize that compliance option will extend the dates of compliance beyond April 9, 2023, there will be an improvement of the air quality in the nonattainment areas, due to the SO<sub>2</sub> emissions reductions as a result of the fuel switching to ULSD in the PREPA Palo Seco and Aguirre gas turbines units. See Figure 3.

---

<sup>5</sup> Final Resolution and Order on the Puerto Rico Electric Power Authority's Integrated Resource Plan. Puerto Rico Energy Bureau. August 2020.

Figure 1: San Juan Non-Attainment Area



Figure 1. The striped area includes the non-attainment municipalities and wards. The map also presents the site location for PREPA San Juan and PREPA Palo Seco.

Figure 2: Guayama-Salinas Non-Attainment Area



Figure 2. The striped area includes the non-attainment municipality and wards. The map also presents the site location for PREPA Aguirre.

Table 1: PREPA Projected SO<sub>2</sub> Allowable Emissions 2019-2029

PREPA Facility	Emission Point	AERMOD Model ID	SO <sub>2</sub> Current Permit Allowable Emission (TPY) 2019-2022	SO <sub>2</sub> Boilers Bunker 6 and Gas Turbines/Combined Cycle ULSDF Interim Plan (TPY) July 1, 2022 <sup>3</sup>		**ULSD Fuel and Emission Units Retirements Final SO <sub>2</sub> Allowable Emission (TPY) 2022-2029	Final Operating Status and Fuel Type 2022-2029	ULSD Fuel Switching or Retirement Date <sup>1</sup>
Palo Seco	Boiler 1	PS1	1966.01	1966.01	Bunker 6	0	Retired	12/31/2022
Palo Seco	Boiler 2	PS2	1966.01	0	-	0	Retired	12/31/2022
Palo Seco	Boiler 3	PS3_1, PS3_2	4517.93	4517.93	Bunker 6	0	Retired	12/31/2024
Palo Seco	Boiler 4	PS4_1, PS4_2	4517.93	4517.93	Bunker 6	0	Retired	12/31/2025
Palo Seco	Power Block 1-1, 1-2	PSGT1_1, PSGT1_2	1333.78	4.0	ULSD	4.0	Operating/ ULSD	2/1/2023
Palo Seco	Power Block 2-1	PSGT2_1	666.89	2.0	ULSD	2.0	Operating/ ULSD	2/1/2023
Palo Seco	<sup>2</sup> Power Block 2-2	PSGT2_2	666.89	0	-	0	Retired	6/30/2023
Palo Seco	<sup>2</sup> Power Block 3-1	PSGT3_1	666.89	0	-	0	Retired	6/30/2023
Palo Seco	<sup>2</sup> Power Block 3-2	PSGT3_2	666.89	0	-	0	Retired	6/30/2023
Palo Seco	FT8 MobilePack 1	MP1	62.66	1.8	ULSD	1.8	Operating/ ULSD	2/1/2023
Palo Seco	FT8 MobilePack 2	MP2	62.66	1.8	ULSD	1.8	Operating/ ULSD	2/1/2023
Palo Seco	FT8 MobilePack 3	MP3	62.66	1.8	ULSD	1.8	Operating/ ULSD	2/1/2023
San Juan	<sup>4</sup> HRSO 5& 6	SJ56	741.96	22.5	ULSD	42.9	Operating ULSD/ LNG	Dual fuel since 2019/ULSD no later than 2/1/2023
San Juan	Boiler 7	SJ7_1, SJ7_2	2368.35	2368.35	Bunker 6	0	Retired	12/31/2022
San Juan	Boiler 8	SJ8_1, SJ8_2	2368.35	2368.35	Bunker 6	0	Retired	12/31/2022
San Juan	Boiler 9	SJ9_1, SJ9_2	2368.35	2368.35	Bunker 6	0	Retired	12/31/2024
San Juan	Boiler 10	SJ10_1, SJ10_2	2368.35	2368.35	Bunker 6	0	Retired	12/31/2022
Aguirre	AG1	AG1_1, AG1_2	9581.5	9581.5	Bunker 6	0	Retired	12/31/2025
Aguirre	AG2	AG2_1, AG2_2	9581.5	9581.5	Bunker 6	0	Retired	12/31/2026
Aguirre	Gas Turbine CC1-1HRSO	CC1-1HRSO	1343.73	4.0	ULSD	0	Retired	12/31/2028
Aguirre	Gas Turbine CC1-2HRSO	CC1-2HRSO	1343.73	4.0	ULSD	0	Retired	12/31/2028
Aguirre	Gas Turbine CC1-3HRSO	CC1-3HRSO	1343.73	4.0	ULSD	0	Retired	12/31/2028
Aguirre	Gas Turbine CC1-4HRSO	CC1-4HRSO	1343.73	4.0	ULSD	0	Retired	12/31/2028
Aguirre	Gas Turbine CC2-1HRSO	CC2-1HRSO	1343.73	4.0	ULSD	0	Retired	12/31/2029
Aguirre	Gas Turbine CC2-2HRSO	CC2-2HRSO	1343.73	4.0	ULSD	0	Retired	12/31/2029
Aguirre	Gas Turbine CC2-3HRSO	CC2-3HRSO	1343.73	4.0	ULSD	0	Retired	12/31/2029
Aguirre	Gas Turbine CC2-4HRSO	CC2-4HRSO	1343.73	4.0	ULSD	0	Retired	12/31/2029
Aguirre	Gas Turbine AGGT2-1, AGGT2-2	AGGT2-1, AGGT2-2	1333.78	4.0	ULSD	4.0	Operating/ ULSD	2/1/2023

<sup>1</sup>Information about emission unit retirements provided by the Puerto Rico Energy Board (PREB).

<sup>2</sup>The PB2-2 and 3-2 are in a retirement process, because PREPA are generating netting credits for the FT8 Mobile Pack permit application. The unit PB3-1 is considered as a retired unit in the IRP, according to the PREB schedule submitted to PRDNER.

<sup>3</sup>Information about ULSD fuel switching provided by PREPA.

<sup>4</sup>This unit was converted to dual fuel Diesel/LNG since late 2019, PREPA's Public Hearing comment. In the Interim Plan, the unit will change from regular diesel to ULSD. For the attainment modeling scenario, the 100% LNG PTE rate was considered because the SO<sub>2</sub> emissions are higher than using ULSD, more conservative scenario.

Figure 3: PREPA Permit PTE and New Projected PTE 2019-2029

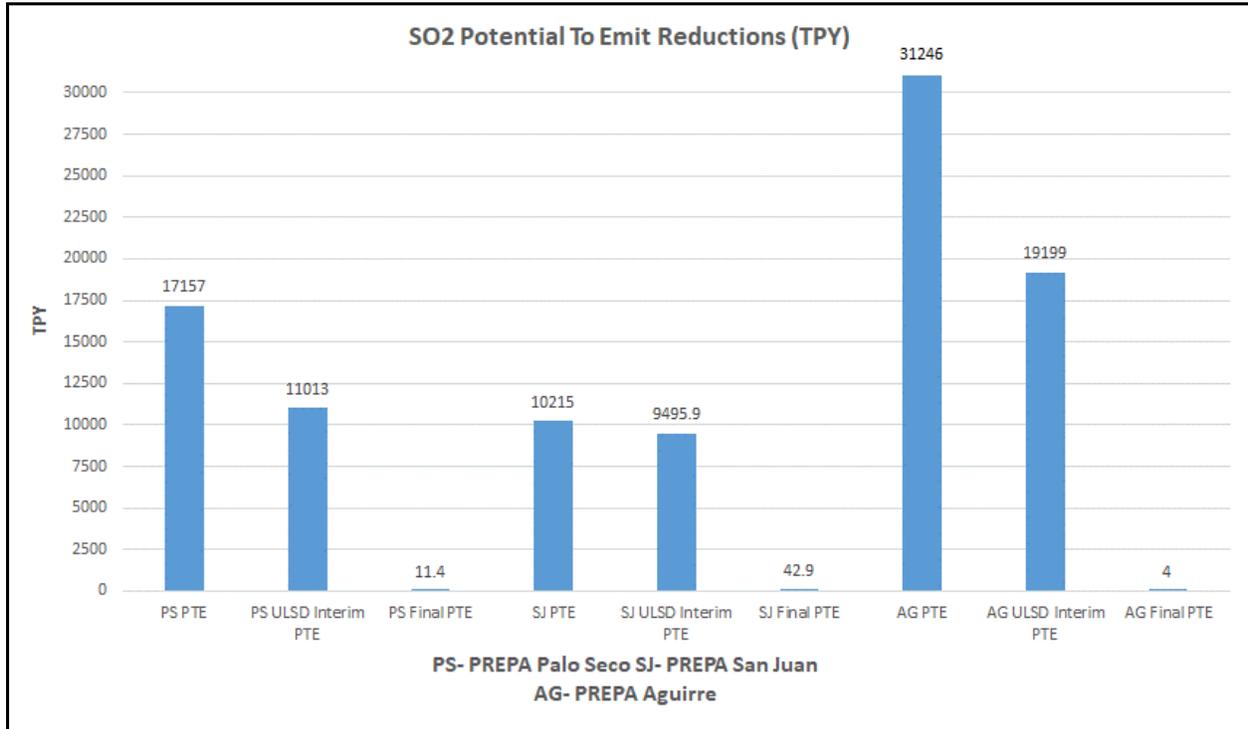


Figure 3. Shows the PREPA current permit SO<sub>2</sub> PTE, and the projected final SO<sub>2</sub> PTE of each PREPA facility, after implementing the recommended emissions reductions that provide compliance with the 1-hour SO<sub>2</sub> NAAQS. PS is PREPA Palo Seco (Includes emissions of the new FT8 Mobile Pack Gas Turbines), SJ is PREPA San Juan and AG is PREPA Aguirre. This chart presents the SO<sub>2</sub> emission reductions from the current permit allowable PTE, to the new projected 2029 permit PTE, considering the switching of PREPA emission units (gas turbines) to ULSD, and the emission unit retirements in each facility, according to the IRP.

## References

1. Technical Support Document: Intended Round 3 Area Designations for the 2010 1-Hour SO<sub>2</sub> Primary National Ambient Air Quality Standard, August 2017. <https://www.epa.gov/sulfur-dioxide-designations/final-technical-support-documents-area-designations-round-3>
2. 2014 Baseline Emission Inventory 1-Hour SO<sub>2</sub> State Implementation Plan. DNER, October 2019.
1. Puerto Rico Integrated Resource Plan 2018-2019, Draft for the Review of the Puerto Rico Energy Bureau. Puerto Rico Power Electric Authority. June 2019.
3. Data Requirements Rule for 2010 1-Hour Sulfur Dioxide (SO<sub>2</sub>) Primary National Ambient Air Quality Standard (NAAQS). 40 CFR Part 51.
4. Puerto Rico Integrated Resource Plan 2018-2019, Draft for the Review of the Puerto Rico Energy Bureau. Puerto Rico Power Electric Authority, June 2019.
5. Final Resolution and Order on the Puerto Rico Electric Power Authority's Integrated Resource Plan. Puerto Rico Energy Bureau. August 2020.

## APPENDIX-A

**PREPA Permit Allowable Emissions Calculation (Bunker 6/Diesel)**  
**PREPA Certified Data**

Unit	Hourly Heat Input Natural Gas (MMBtu/Hr)	SO <sub>2</sub> Hourly Rate (lbs/Hr) Natural Gas	Sulfur Content Permit Limit (%wt)	Hourly Heat Input Fuel Oil No. 2 (MMBtu/Hr)	SO <sub>2</sub> Hourly Rate (lbs/Hr) Diesel Fuel Oil No. 2	Sulfur Content Permit Limit (%wt)	Hourly Heat Input Fuel Oil No. 6 (MMBtu/Hr)	SO <sub>2</sub> Hourly Rate (lbs/Hr) Bunker C Fuel Oil No. 6	Sulfur Content Permit Limit (%wt)	Emission Factor AP 42 (157)*%S lb/1000gal	Emission Factor Permit Natural Gas (lb/MMBtu)	Emission Factor Permit (lb/MMBtu)	Emission Factor Mass Balance (lb/MMBtu)	Estimated TPY PTE (PREPA)	
AG1							4180	2187.5	0.5	(157)*%S lb/1000gal				9581.4	
AG2							4180	2187.5	0.5	(157)*%S lb/1000gal				9581.4	
AG GT 2-1				301.5	152.3	0.5				1.01*%S lb/MMBTU				666.9	
AG GT 2-2				301.5	152.3	0.5				1.01*%S lb/MMBTU				666.9	
AG CCGT 1-1				607.5	306.8	0.5				1.01*%S lb/MMBTU				1343.7	
AG CCGT 1-2				607.5	306.8	0.5				1.01*%S lb/MMBTU				1343.7	
AG CCGT 1-3				607.5	306.8	0.5				1.01*%S lb/MMBTU				1343.7	
AG CCGT 1-4				607.5	306.8	0.5				1.01*%S lb/MMBTU				1343.7	
AG CCGT 2-1				607.5	306.8	0.5				1.01*%S lb/MMBTU				1343.7	
AG CCGT 2-2				607.5	306.8	0.5				1.01*%S lb/MMBTU				1343.7	
AG CCGT 2-3				607.5	306.8	0.5				1.01*%S lb/MMBTU				1343.7	
AG CCGT 2-4				607.5	306.8	0.5				1.01*%S lb/MMBTU				1343.7	
PS1							857.7	448.9	0.5	(157)*%S lb/1000gal				1966.0	
PS2							857.7	448.9	0.5	(157)*%S lb/1000gal				1966.0	
PS3							1971	1031.5	0.5	(157)*%S lb/1000gal				4517.9	
PS4							1971	1031.5	0.5	(157)*%S lb/1000gal				4517.9	
PS GT 1-1				301.5	152.3	0.5				1.01*%S lb/MMBTU				666.9	
PS GT 1-2				301.5	152.3	0.5				1.01*%S lb/MMBTU				666.9	
PS GT 2-1				301.5	152.3	0.5				1.01*%S lb/MMBTU				666.9	
PS GT 2-2				301.5	152.3	0.5				1.01*%S lb/MMBTU				666.9	
PS GT 3-1				301.5	152.3	0.5				1.01*%S lb/MMBTU				666.9	
PS GT 3-2				301.5	152.3	0.5				1.01*%S lb/MMBTU				666.9	
PS MP1	294.8	4.125	5.0	283.3	14.3	0.05					0.014	0.0505		62.7	
PS MP2	294.8	4.125	5.0	283.3	14.3	0.05					0.014	0.0505		62.7	
PS MP3	294.8	4.125	5.0	283.3	14.3	0.05					0.014	0.0505		62.7	
SJ7							1007.3	540.7	0.5					0.537	2368.4
SJ8							1007.3	540.7	0.5					0.537	2368.4
SJ9							1007.3	540.7	0.5					0.537	2368.4
SJ10							1007.3	540.7	0.5					0.537	2368.4
SJ5 + SJ6	3496	9.78	1 gr/100dscf	3388	169.4	0.05					0.0028	0.05		742.0	

**Fuel Characteristics**

Parameter	Value	Units	Clarifier
Fuel Oil No. 6			
Sulfur Content (limit)	0.5	%wt	As measured
Heating Value	150,000	Btu/gal	EQB Clarification
Density	8.06	lbs/gal	EQB Clarification
Molecular Weights			
Hydrogen (H)	1.01	lb/lbmol	
Sulfur (S)	32.06	lb/lbmol	
Oxygen (O)	16.00	lb/lbmol	

[http://www.etc-cte.ec.gc.ca/databases/oilproperties/pdf/web\\_bunker\\_c\\_fuel\\_oil.pdf](http://www.etc-cte.ec.gc.ca/databases/oilproperties/pdf/web_bunker_c_fuel_oil.pdf)

density is equivalent to a 15 API Gravity used in current permit applications and annual emissions inventory reporting <https://engineeringunits.com/api-gravity-calculator/>

**PREPA Permit Allowable Emissions Calculation (Bunker 6/Diesel)  
 PREPA Certified Data**

**Fuel  
 Characteristics**

Parameter	Value	Units	Clarifier
Fuel Oil No. 2			
Sulfur Content (limit)	0.05	%/wt	As measured
Heating Value	138,000	Btu/gal	EQB Clarification
Density	7.05	lbs/gal	AP-42
Molecular Weights			
Hydrogen (H)	1.01	lb/lbmol	
Sulfur (S)	32.06	lb/lbmol	
Oxygen (O)	16.00	lb/lbmol	

SO <sub>2</sub> lb/MMBtu Emission Factor from Mass Balance (where Applicable)						
SO <sub>2</sub>	lb	=	S%	Fuel Density lb	1 gal of fuel	lbmol SO <sub>2</sub>
	MMBtu		100	gal	Fuel Heat Content (MMBtu)	lbmol S
<b>Diesel</b>						
SO <sub>2</sub>	lb	=	0.05	7.05	1	64.058 =
	MMBtu		100		0.138	32.06
* Mass Balance Assumes all sulfur converts to SO <sub>2</sub>						
SO <sub>2</sub>	lb	=	S%	Fuel Density lb	1 gal of fuel	lbmol SO <sub>2</sub>
	MMBtu		100	gal	Fuel Heat Content (MMBtu)	lbmol S
<b>Bunker C</b>						
SO <sub>2</sub>	lb	=	0.5	8.06	1	64.058 =
	MMBtu		100		0.150	32.06
* Mass Balance Assumes all sulfur converts to SO <sub>2</sub>						

**PREPA Aguirre Gas Turbines/ Combined Cycle Emission Calculation (ULSD)  
 PREPA Certified Data**

Power Block/Boiler Units	ULSD Heat Input Rates MMBtu/Hr	Stack	Emission Rates PTE. 100% load, 0.0015 %/wt ULSD
			Lb/Hr SO <sub>2</sub>
AG1	-	AG1-1	retired
	-	AG1-2	retired
AG2	-	AG2-1	retired
	-	AG2-2	retired
AGGT2	301.5	AGGT2-1	0.46
	301.5	AGGT2-2	0.46
CC1	-	CC 1-1HRSG	retired
	-	CC 1-2HRSG	retired
	-	CC 1-3HRSG	retired
	-	CC 1-4HRSG	retired
CC2	-	CC 2-1HRSG	retired
	-	CC 2-2HRSG	retired
	-	CC 2-3HRSG	retired
	-	CC 2-4HRSG	retired

\* According to IRP, only gas turbines AGGT2-1, 2-2 will stay operating in PREPA Aguirre.

**PREPA Certified Data**  
**PREPA Palo Seco Gas Turbines Emission Calculation (ULSD)**

Power Block/Boiler Units	Stack	ULSD Heat Input	PTE. 100% load, units retirements and other in ULSD 0.0015%/wt
		MMBtu/HR	Lb/Hr SO <sub>2</sub>
PS1	PS1	-	retired
PS2	PS2	-	retired
PS3	PS3-1	-	retired
	PS3-2	-	retired
PS4	PS4-1	-	retired
	PS4-2	-	retired
PB1	PSGT1-1	301.5	0.5
	PSGT1-2	301.5	0.5
PB2	PSGT2-1	301.5	0.5
	PSGT2-2	-	retired
PB3	PSGT3-1	-	retired
	PSGT3-2	-	retired
PS MP1	PSMP1-1	283.3	0.4
PS MP2	PSMP2-1	283.3	0.4
PS MP3	PSMP3-1	283.3	0.4

\* According to the IRP, only gas turbines PSGT 1-1, 1-2, 2-1 and Mobile Pack 1-1, 2-1, 3-1 will stay operating in PREPA Palo Seco.

<b>ULSD Emissions for Gas Turbines Palo Seco and Aguirre</b>			
	<b>Emission Factor AP 42</b>		
	1.01*%S lb/MMBTU	Fuel Oil No. 2 and ULSD	
		<b>Ultra Low Sulfur Diesel ULSD</b>	
		Sulfur Content	
		0.0015 %/wt	
	<b>PS MobilePac and PB Emission Factor, ULSD</b>		
	0.001515 lb/MMBtu		
<b>Heating Rates</b>	<b>Power Block/MP</b>	<b>MMBtu/Hr</b>	<b>Fuel</b>
	PS PB1, PB2, PB3	603	Fuel Oil No 2, ULSD
	PS MP1, MP2, MP3	283.3	Fuel Oil No 2, ULSD
	AG GT	301.5	Fuel Oil No 2, ULSD
	AG CCGT	607.5	Fuel Oil No 2, ULSD

**PREPA Certified Data**  
**PREPA San Juan Gas Turbines Emission Calculation (ULSD/LNG)**

PREPA San Juan	Stack	Heat Input MMBtu/HR		PTE. 100% load ULSD 0.0015%/wt	PTE. 100% load Natural Gas*
		ULSD	Natural Gas	Lb/Hr SO <sub>2</sub>	Lb/Hr SO <sub>2</sub>
SJ5+6	SJ5&6	3388	3496	5.1	9.8
SJ7	SJ7-1	-	-	-	retired
	SJ7-2	-	-	-	retired
SJ8	SJ8-1	-	-	-	retired
	SJ8-2	-	-	-	retired
SJ9	SJ9-1	-	-	-	retired
	SJ9-2	-	-	-	retired
SJ10	SJ10-1	-	-	-	retired
	SJ10-2	-	-	-	retired

\*The unit SJ5&6 is dual fuel since late 2019 and switch to ULSD in 2022. For inventory purposes we included both emission rates, but for attainment demonstration, PRDNER use the most conservative rate or LNG 100% load.

<b>Emission Factor AP 42</b>	
<b>SJ5&amp;6</b>	
<b>1.01 *%S lb/MMBTU</b>	<b>Fuel Oil No. 2 and ULSD</b>

Natural Gas	0.00102	MMBtu/Gal																	
<b>Natural Gas Fuel Characteristics &amp; Emission Factor (Mass Balance)</b>																			
Parameter	Value	Units	Clarifier																
Natural Gas																			
Sulfur Content (limit)	5	gr/100 dscf	As measured																
Heating Value	1,020	Btu/scf																	
1 lb = 7000 grains																			
<b>Molecular Weights</b>																			
Hydrogen (H)	1.01	lb/lbmol																	
Sulfur (S)	32.06	lb/lbmol																	
Oxygen (O)	16.00	lb/lbmol																	
Mass Balance Assumes all sulfur converts to SO <sub>2</sub>																			
Natural Gas																			
Sulfur Content																			
5	gr/100 dscf																		
1	gr/100 dscf		San Juan 5/6 Permit Limit																
<b>Nat. Gas - San Juan 5/6</b>																			
SO <sub>2</sub> lb	=		1	gr	1	lb	1	dscf	1000000	Btu	64.058	=	0.0028						
MMBtu		100	dscf	7000	gr	1,020	Btu	1	MMBtu	32.06									
Mass Balance Assumes all sulfur converts to SO <sub>2</sub>																			

### PREB-IRP Retirement Schedule

Updated PREPA's Fossil Fuel Retirement Assessment According to the Approved Integrated Resources Plan

PREPA Facility	Generation Unit	Retirement Date
Palo Seco Steam	Boiler 1	Not considered as an available resource in the Approved IRP. Requires major repair. <b>Retire by December 31, 2022</b>
Palo Seco Steam	Boiler 2	Not considered as an available resource in the Approved IRP. Requires major repair. <b>Retire by December 31, 2022</b>
Palo Seco Steam	Boiler 3	Available but repairs required. <b>Retire by December 31, 2024.</b>
Palo Seco Steam	Boiler 4	Available but repairs required. <b>Retire by December 31, 2025.</b>
Palo Seco GT	Power Block 1-1, 1-2	Three new diesel Multi-Pack GTs in place at Palo Seco (81 MW total). Three of six older units available (Power blocks 1-1, 1-2, and 2-1), 63 MW total. <b>Remaining (Power Blocks 2-2, 3-1,3-2) retire by June 2023.</b>
Palo Seco GT	Power Block 2-1	
Palo Seco GT	Power Block 2-2	
Palo Seco GT	Power Block 3-1	
Palo Seco GT	Power Block 3-2	
San Juan Steam	Boiler 7	Unit limited availability / requires repair. <b>Retire December 2022.</b>
San Juan Steam	Boiler 8	Unit limited availability / requires repair. <b>Retire December 2022.</b>
San Juan Steam	Boiler 9	Not considered as an available resource in the IRP, limited functionality now. <b>Retire by December 31, 2024.</b>
San Juan Steam	Boiler 10	Not considered as an available resource in the Approved IRP. Requires major repair. <b>Retire by December 31, 2022</b>
Aguirre Steam	AG1	<b>Retire December 31, 2025.</b>
Aguirre Steam	AG2	<b>Retire December 31, 2026.</b>
Aguirre CC	Gas Turbine CC1-1HRSG	<b>Retire December 31, 2028</b>

**PREB-IRP Retirement Schedule (Cont.)**

Aguirre CC	Gas Turbine CC1-2HRSG	Retire December 31, 2028
Aguirre CC	Gas Turbine CC1-3HRSG	Retire December 31, 2028
Aguirre CC	Gas Turbine CC1-4HRSG	Retire December 31, 2028
Aguirre CC	Gas Turbine CC2-1HRSG	Retire December 31, 2029
Aguirre CC	Gas Turbine CC2-2HRSG	Retire December 31, 2029
Aguirre CC	Gas Turbine CC2-3HRSG	Retire December 31, 2029
Aguirre CC	Gas Turbine CC2-4HRSG	Retire December 31, 2029

Based on February 14, 2022 Generation Directorate, PREPA response to ROI #5, 2/14/2022, NEPR-MI-2021-0002,

Note: range of uncertainty as to availability and operational status of units. Retirement estimate made based on capacity balance and planned procurements.

\*Table submitted to PRDNER on May 27, 2022.